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Energy saved by using dc flywheel power for servers

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A demonstration project is underway to show how dc power and flywheels can save huge amounts of power in server-based applications; tours are available by appointment. Pentadyne Power Corp., manufacturer of clean energy storage systems using advanced composite flywheel technology, announced participation in a project at the Sun Microsystems' campus in Silicon Valley to prove that data centers can conserve massive amounts of energy and drastically reduce utility bills by using direct current (dc) architecture to run power-hungry servers connected to the Internet.

Those involved include researchers and system engineers at the U.S. Department of Energy's Lawrence Berkeley National Laboratory, California Energy Commission, Sun Microsystems, Intel, Cisco, Pentadyne, and others. Purpose is to demonstrate how the nation's data centers could amass billions of dollars in utility savings by using dc architecture that would conserve thousands of gigawatthours of energy per year. One gigawatthour is enough energy to power more than 60,000 average homes for one year.

With 17% of U.S. data centers in San Francisco and Silicon Valley areas, the energy savings could help mitigate California's energy crisis and summertime rolling blackouts, Pentadyne says. Applied nationwide, reduced demand on U.S. utility power generation could cut annual emissions of smog-forming NOx by 2 million pounds and reduce carbon dioxide greenhouse gas emissions by nearly a billion pounds, according to U.S. EPA utility power plant emission statistics.

At Sun Microsystems in Newark, CA, Pentadyne supplied the flywheel-based clean energy storage system connected to a rectifier that converts the incoming utility grid ac into 400 V dc power. A fast spinning composite flywheel replaces conventional UPS (uninterruptible power supply) battery banks that store energy to seamlessly continue power to the data center equipment in the event of a blackout or other power disturbance. Using dc power instead of alternating current (ac) can reduce energy needed to run data centers by up to 20% and improve overall system reliability, Pentadyne says; servers from major manufacturers have been tested to operate within the dc architecture.

Pentadyne's Mark McGough, president and CEO, explains, "Combining dc-powered equipment with clean energy storage flywheel-UPS systems eliminates costly, maintenance-laden and polluting batteries, radically cuts cooling system needs and the energy to run those systems, and improves overall server reliability while dramatically reducing floor space."

Technology advantages, according to Pentadyne, include elimination of downstream static, transfer switches, harmonics, power factor concerns, and UPS equipment. It also simplifies grounding. Using dc power and high-speed flywheel energy storage systems eliminates inefficiencies that generate heat.

In the typical data center, the power distribution system converts 480 V ac utility power through a transformer that steps it down to 208 V ac that feeds racks of servers. Individual power supplies (typically redundant) within each server unit converts this into a dc voltage appropriate for that unit's needs. The Sun Microsystems campus converts 480 V ac utility power into dc power at voltages appropriate for data center equipment. By skipping or consolidating conversion steps, this approach can save as much as 20% electricity use and eliminate heat, Pentadyne says.

Data centers "can use 100 times the electricity of a typical office building on a square foot basis," says William Tschudi, the Berkeley Lab principal investigator for the project. "Energy costs of $1 million per month are not uncommon in large data centers that require megawatts of electricity."

Tours of the Sun Microsystems campus demonstration (Newark, CA) are available by appointment through August 2006.

Emission reduction estimates are based on the Berkeley Lab's estimated 500-MW data center (4,380,000 megawatthours/yr) and the EPA's Power Profiler national averages, using an estimated 15% average power conservation via dc power. Click here to see the EPA Power Profiler.

Pentadyne Power is based in Chatsworth, CA.

--Edited by Mark T. Hoske, *Control Engineering* editor in chief

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